Turbulent transport model in a three-dimensional structured solar wind

Turbulent transport model in a three-dimensional structured solar wind

*塩田 大幸[1]、Zank Gary[2]、Adhikari Laxman[2]、Peter Hunana[2]
*Daikou Shiota[1], Gary P. Zank[2], Laxman Adhikari[2], Peter Hunana[2]

1.名古屋大学 宇宙地球環境研究所、2. Center for Space Plasma and Aeronomic Research (CSPAR) and the Department of Space Science, The University of Alabama in Huntsville, USA
1.Institute for Space and Earth Environmental Research, Nagoya University, 2. Center for Space Plasma and Aeronomic Research (CSPAR) and the Department of Space Science, The University of Alabama in Huntsville, USA

Turbulence plays an essential role in the heating of coronal and solar wind plasma and the acceleration of the solar wind, as well as acceleration of energetic particles associated with interplanetary shocks. Turbulence can be produced by energetic particles and shocks and the radial and lateral inhomogeneity of the global interplanetary magnetic field and solar wind plasma distribution. Because of the close coupling of turbulence, plasma heating, the global solar wind structure, and energetic particles, a comprehensive model describing not only turbulence but also the large-scale inhomogeneity of the solar wind and the interplanetary magnetic field is necessary to understand the physics of these phenomena.

Recently we have developed a solar wind MHD model for the inner heliosphere based on synoptic observations of the photospheric magnetic field (Shiota et al. 2014). The numerical results show reasonable agreement with in situ measurements of the solar wind at the orbits of Earth, Venus, and Mars. This MHD model is now used as part of the real-time space weather forecast system SUSANOO (http://st4a.stelab.nagoya-u.ac.jp/susanoo/).

We have extended our 3D MHD model to include the transport and dissipation of turbulence using the theoretical model developed by Zank et al. (2012). We solve a coupled model that describes the 3D inhomogeneous solar wind and the temporal and spatial evolution of three moments or variables that describe turbulent fluctuation intensities (the energy in forward and backward modes and the residual energy) and their corresponding correlation lengths. We find that the radial profiles for the three moments of the solar wind turbulence predicted by our model show good agreement with those of in situ measurements obtained from Ulysses and Helios observations. Based on the detailed analysis of the numerical results, we will discuss the connection between turbulence generation and global solar wind structure.

キーワード：太陽風、MHD、乱流
Keywords: solar wind , MHD, turbulence

